

Sandia National Laboratories

OVERVIEW

Spring 2005



National

Security

is Our

Business



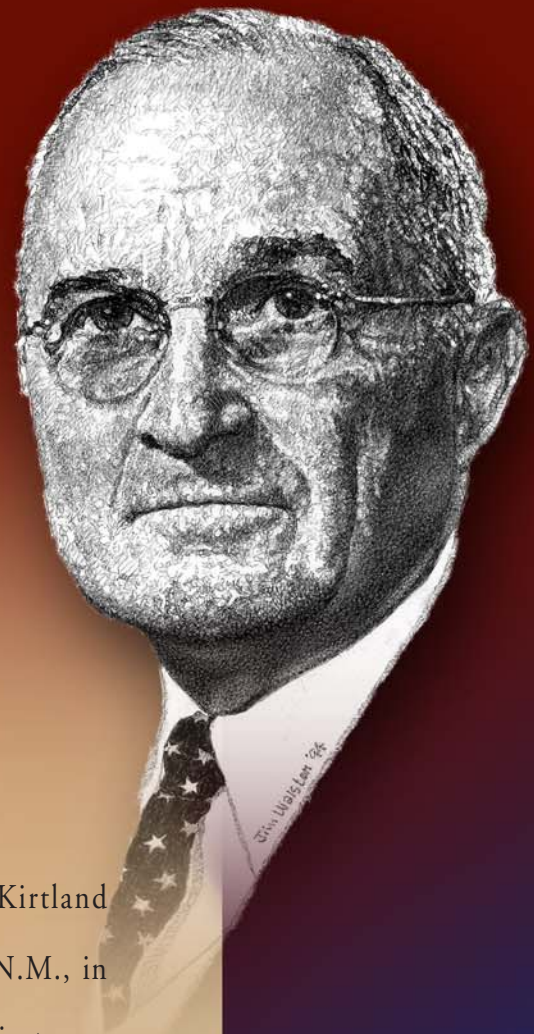
**Sandia
National
Laboratories**

A Department of Energy
National Laboratory

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OVERVIEW

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Sandia was established on Kirtland Air Force Base in Albuquerque, N.M., in 1945 during the Manhattan Project as a division of the Los Alamos Laboratory to provide engineering design, production, assembly, and field testing of non-nuclear components of nuclear weapons. On request of President Harry Truman, Sandia became an independent laboratory on Nov. 1, 1949, and opened its Livermore, Calif., facilities in 1956. Sandia is now a multiprogram national security laboratory.

Sandia at a Glance

Missions: Sandia's missions meet national needs in five key areas:

- Nuclear Weapons — Ensuring the stockpile is safe, secure, reliable, and can support our nation's deterrence policy
- Nonproliferation and Assessments — Reducing the proliferation of weapons of mass destruction, the threat of nuclear accidents, and the potential for damage to the environment
- Military Technologies and Applications — Helping to maintain superiority of our armed forces
- Homeland Security — Helping to protect our nation against terrorism
- Energy and Infrastructure Assurance — Keeping America's resources and information flowing

Research Foundations and Emerging Areas:


- Materials and process sciences
- Computational and information sciences
- Microelectronics and photonics sciences
- Engineering sciences
- Pulsed power sciences
- Manufacturing sciences
- Surety sciences
- Chemical and earth sciences
- Biotechnology

Employees: About 8,500 (full-time equivalents)

Locations: Main facilities in Albuquerque, N.M., and Livermore, Calif.; missile test ranges in Tonopah, Nev., and Kauai, Hawaii; the Pantex Plant weapons facility near Amarillo, Texas; and the Carlsbad, N.M., Field Office, which leads the nation's transuranic waste disposal efforts.

Annual Budget: About \$2.3 billion (FY05 projected)

Management: Sandia is managed by a subsidiary of Lockheed Martin Corporation for the Department of Energy's (DOE) National Nuclear Security Administration (NNSA). Sandia also works for and partners with other DOE agencies, the Department of Defense (DoD), the Department of Homeland Security (DHS), other federal, state, and local agencies and governments, private industry, and academic institutions to accomplish our missions.

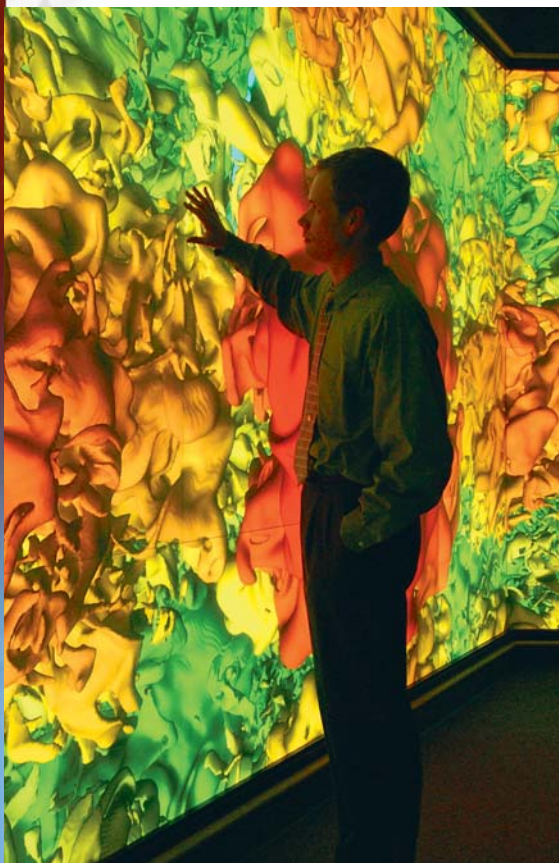


Sandia President Paul Robinson demonstrates a prototype white-light semiconductor light-emitting diode (LED) device at the 2004 State of the Labs presentation. The amazingly bright light comes from two 4-watt LEDs made by Sandia partner Lumileds.

National Security is Our Business

Sandia began in the mid-1940s with a single mission around nuclear weapons design and production, and has since grown into a broad national security laboratory encompassing a variety of technologies and programs. Sandia's core purpose today is to help our nation secure a peaceful and free world through technology. Our national security missions span five key areas, listed on the previous page and explained beginning on page 4.

A Sandian studies a materials interaction shown as a computer simulation in Sandia's visualization corridor. Computer modeling and simulations are becoming integral to understanding all types of complex phenomena in science and engineering.



In brief, we develop technologies to sustain, modernize, and protect our nuclear arsenal, prevent the spread of weapons of mass destruction, protect our national infrastructures, defend our nation against terrorism, provide new capabilities to our armed forces, and ensure the stability of our nation's energy and water supplies. Our science, technology, and engineering program ensures the nation will maintain national technological superiority and preparedness — keys to national defense, homeland security and our economic well-being.

We not only respond to national security needs as they develop, we “think in the future tense” about new types of threats that may develop soon or even years down the road — and work to develop solutions before those threats become reality.

Examples of Sandia-developed national security technologies:

Throughout our nearly 60-year history, Sandia has developed and refined numerous national security technologies and innovations. Notable examples include:

A US missile defense target rocket lifts off from Sandia's Kauai Test Facility in December 2003. Sandia provides launch support for various Missile Defense Agency programs.





Synthetic aperture radar (SAR) image of Washington, D.C. Sandia is the world's leader in developing the all-weather, day/night imaging technology.

- Thousands of advancements that have made modern nuclear weapons increasingly safe, secure, and reliable.
- MicroChemLab/CB™ (chemical/biological), a handheld system that quickly and accurately detects and identifies harmful chemical and biological agents.
- Synthetic aperture radar, an all-weather, day/night imaging technology that enables mapping with a precision thousands of times greater than today's maps for both military and civilian applications.
- PAN Disrupter™, which disables and dismantles explosive devices (without detonation) by defeating the physics of the devices.
- Decontamination foam, a nontoxic substance that can be sprayed quickly over wide areas, rendering harmless many dangerous chemical and biological agents.
- Intelligent machines and robotics that perform many security and law-enforcement tasks effectively and efficiently without putting humans in harm's way.
- Collective intelligence, the integration of computers, sensors, and robotic systems into highly refined systems that are able to collaboratively carry out highly complex tasks such as guarding a perimeter or searching a building for intruders or harmful substances.
- Cybersecurity systems that use software agents, much like white blood cells patrolling our vascular network, to detect and defend against computer hacking.
- Remote sensing for intelligence gathering, with platforms that range from unattended ground sensors, to unmanned aerial vehicles, to new, smaller satellites that can communicate information in real time.

Alex Maish checks out SandDragon, developed for use in rugged outdoor terrain. SandDragon offers military surveillance, reconnaissance, target acquisition, and response options.



Five National Security Mission Areas

Richard Fitak checks W80 Command Disable System Tester that is used at the Department of Energy's Pantex Plant, America's only nuclear weapon assembly and disassembly facility.

Many satellites involved in surveillance missions, including this Defense Support Program Satellite, carry payloads designed and built by Sandia.

(Illustration courtesy of U.S. Air Force)

1. Nuclear weapons: This is Sandia's biggest and most enduring mission. We are responsible for the research, design, and development of more than 90 percent of the 3,000 to 6,500 components of a modern nuclear weapon. These components include security systems, arming and fuzing mechanisms, safety systems, instrumentation, parachute systems, and aerodynamic design. We also conduct surviv-



ability tests, develop robotic systems to dismantle retired weapons, help clean nuclear waste sites, and test containers to ensure they protect nuclear materials during transport. Sandia uses highly sophisticated computer simulations and conducts nuclear fusion research to understand and model the behavior of nuclear weapons.

2. Nonproliferation and Assessments (NP&A): Sandia provides enabling systems, science, technology, and expertise to reduce

the threat to the U.S. from weapons of mass destruction. We also provide performance and vulnerability assessments of U.S. and foreign technical capabilities and associated assessment tools and technologies. This is vital to national security because of advances in technologies for developing biological, as well as chemical, nuclear, and even unconventional weapons. The NP&A program supports U.S. efforts worldwide to reduce existing stocks of nuclear materials. We also support verification and monitoring efforts for detecting and controlling the proliferation of weapons of mass destruction.

3. Military Technologies and Applications: Sandia helps the U.S. maintain weapon-systems superiority, critical in fighting terrorism and equipping our armed forces for future conflicts. Our military is transforming from a focus on



major theater warfare to a force that is responsive, agile, and versatile. Sandia's strengths in basic and applied research, missile defense, surveillance and reconnaissance, robotics, modeling/simulation, and large system analysis and integration play a strategic role in this transformation. Sandia develops and fields advanced technologies that can detect, locate, characterize, defend against, and, if necessary, destroy increasingly sophisticated technologies being used by other nations and terrorist groups.

4. Homeland Security: The Department of Homeland Security (DHS) faced huge organizational and system-integration challenges as it began operating in 2003, drawing more than 200 agencies under one umbrella. Sandia was called on to help the DHS establish science, technology, and information programs. Sandia's assistance included assigning technical employees to work at DHS headquarters; seven Sandians remained in DHS assignments as of late 2004. Sandia's antiterrorism and counterterrorism involvement began years ago as part of our work to develop technologies to protect nuclear weapons and facilities. Much of this now is being adapted to help our nation guard against biological, chemical, and radiological threats.

5. Energy and Infrastructure Assurance: Sandia develops solutions to ensure the nation has clean, abundant, and affordable energy and water. We are making strides in the areas of energy research, earth sciences, transportation systems, risk management technologies, environmental stewardship, and nuclear waste management. Sandia is also actively working to improve the nation's critical infrastructure surety (safety, security, and reliability). We are developing means to strengthen the infrastructure in the areas of transportation, electric power grid, oil and gas distribution, telecommunications, finance and banking, and vital human services.



Kevin Linker displays a MicroHound™ chemical sniffer, similar to units evaluated in 2003 by federal emergency response teams. Linker and other Sandians cooperatively developed this technology.



Sandia is working with the Air Force and the defense industry to apply a variety of Sandia technology to advanced fighter aircraft including the F-22 Raptor (seen here) and the Joint Strike Fighter.



Sandia's annular core research reactor is used in various weapons and energy testing programs. Here, Ron Farmer inspects equipment before a test.

Research & Development

Sandia scientists and engineers conduct a broad range of research and development projects. These projects usually are in one of our five research foundations:

1. Materials and process sciences: Provides the scientific basis for technical options and decisions about polymers, ceramics, and metals and the interfaces among these material combinations in nonnuclear components for the stockpile.

2. Computational and information sciences: Develops technology to revolutionize scientific studies and engineering practices via greater reliance on modeling and simulation.

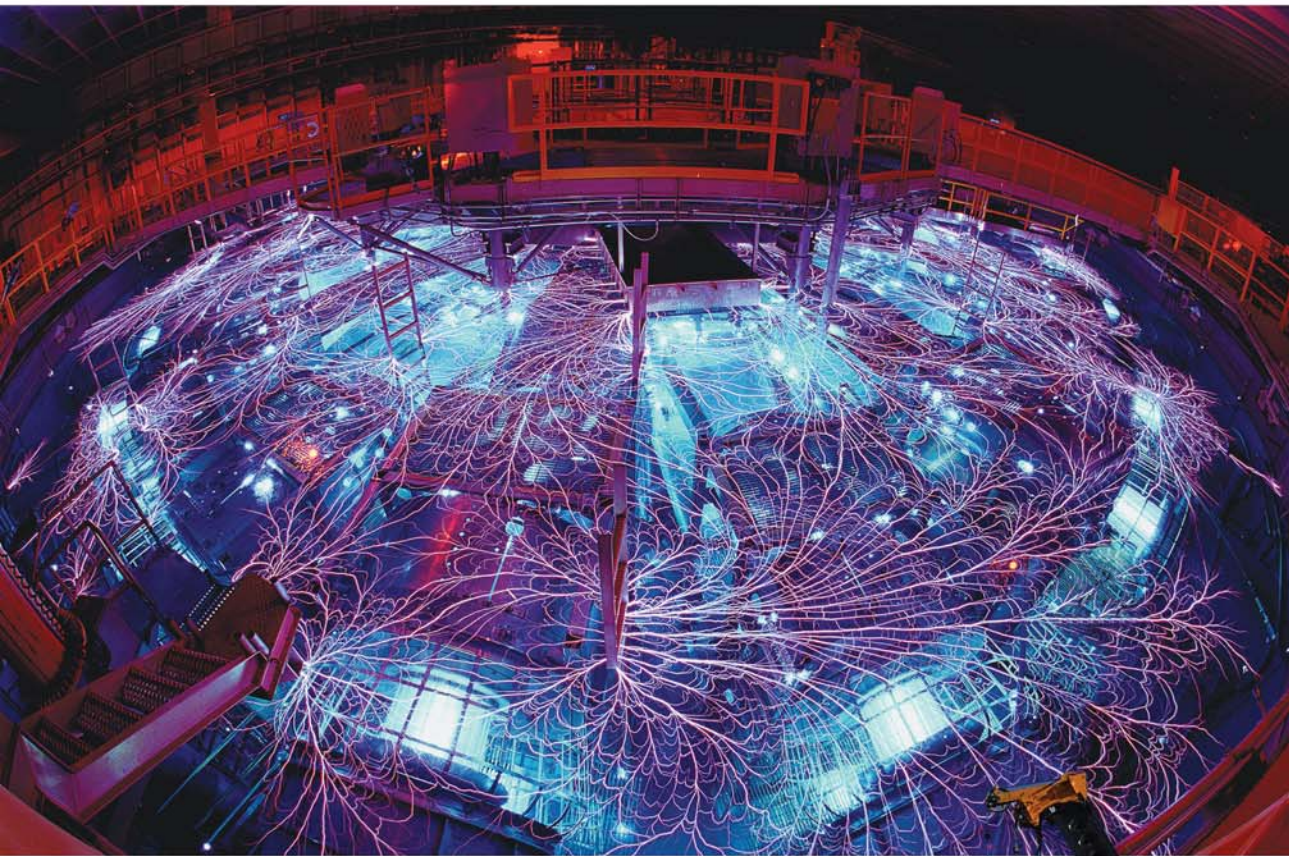
3. Microelectronics and photonics sciences: Provides the underlying science and technology to ensure state-of-the-art implementation of Sandia's electronics systems.

4. Engineering sciences:

Supports core research, development, and applications that ensure the highest caliber of experiments, theory, and computations in support of our missions.

The Microsystems and Engineering Sciences Applications (MESA) project is the largest capital construction project in Sandia's history. MESA will play a major role in advancing the state of the art in microsystems research and development and in incorporating integrated microsystems into the nuclear stockpile.





The world's most powerful x-ray generator, Sandia's Z machine is used to test the effects of radiation on weapon components and for fusion energy research. The Z machine routinely heats deuterium pellets to temperatures that exceed those in the sun.

5. Pulsed power sciences: Applies scientific and technological advances to a broad range of missions for the Department of Energy, National Nuclear Security Administration, Department of Defense, other federal agencies, and other customers.

Sandia has also identified four emerging areas that may be future research foundation candidates: Manufacturing sciences, surety sciences, chemical and earth sciences, and biotechnology.



A "retired" Boeing 727 fuselage arrives in late 2003 at Sandia's Airworthiness Assurance Center where it is being used in aircraft safety research.

Technology Commercialization

Sandia has developed and helped commercialize many technologies.

The laminar-flow cleanroom, used worldwide for manufacturing microelectronics, pharmaceuticals, food products, and for hospital surgery, was invented at Sandia in 1960. The technology uses a uniform flow of filtered air from the ceiling to the floor grates, or wall to wall, to remove contaminants from the air.

In 1997, a cooperative research and development agreement (CRADA) linked an Intel-led industry consortium with the Virtual National Laboratory (Sandia, Lawrence Livermore, and Lawrence Berkeley national laboratories) to develop Extreme Ultraviolet Lithography (EUVL), a system that will allow semiconductor manufacturers to move beyond the current physical limitations for printing circuits on microchips. EUVL is aiding the development of ever-smaller components for military and commercial electronics applications.

MicroChemLab™ systems provide a fast, portable way for first responders to detect harmful chemical and biological agents.



Sandia researchers work with Extreme Ultraviolet Lithography system equipment, expected to lead to dramatic improvements in the speed and memory of computer systems.

Other commercialized technologies include:

- A walk-through explosives detection portal, developed for the Federal Aviation Administration to screen passengers for explosives.
- Bomb disablement technologies that allow bomb technicians to “render safe” both crude and sophisticated terrorist-type explosive devices without having to approach the bombs.
- A family of risk assessment methodologies (RAMs) that can be used for dams (RAM-D), power transmission systems (RAM-T), and water distribution systems (RAM-W) to identify and correct vulnerabilities.
- Gunpowder residue detector field kits that help police and military personnel instantly determine if someone has recently fired a weapon.
- Lithium battery anode material that may double the energy storage capacities of current anodes, leading to rechargeable lithium-ion batteries with more power, longer life, and smaller sizes.
- A spread-spectrum 2-D barcode that is more secure, reliable, and inexpensive than standard barcodes. The entire message can be read even when a significant fraction of the barcode is occluded or damaged.
- Jess™ (Java Expert System Shell) is a rule engine that can build Java software that has the capacity to “reason” using knowledge supplied by the user. Jess is small, light, and one of the fastest rule engines available.
- Hydrogen getter materials that reduce the risks of explosion when hydrogen mixes with oxygen in sealed items, such as electronics, heat-exchange equipment, vacuum maintenance, and battery-operated devices by irreversibly scavenging unwanted hydrogen gas.
- Handheld and unmanned vehicle-carried MicroChemLab™ systems that can detect and signal chemical/biological agents for homeland security, defense, and environmental applications.



Explosives expert Pam Walker and Sandian Mike Walker, an Army Reserve major, demonstrate a Sandia-developed instant shooter ID kit that has been commercialized by Sandia partner Law Enforcement Technologies, Inc.

Sandia has some of the world's top bomb-disablement experts and technology. Here, Chris Cherry briefs police bomb squad members before a live demonstration at a training session.



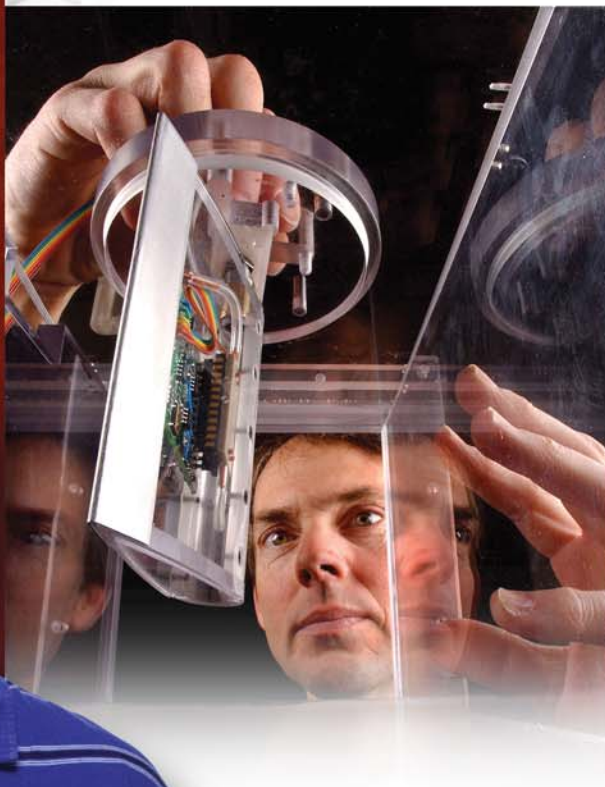
Business Partnerships

Sandia works closely with industry, universities, and government agencies to bring new technologies to the marketplace. Much of Sandia's technology commercialization results from such partnerships. Sandia has been partnering with industry to commercialize technologies for more than three decades. Partnerships with industry create a crucial supplier base for Sandia-developed technologies,

import best business and engineering practices from industry into Sandia, and support U.S. industry.

Sandia negotiates technology commercialization agreements to allow collaboration with industry on mutually beneficial research. Other options include commercial licensing agreements, technical assistance, use of unique Sandia user facilities (see page 12), technical personnel exchanges, and memoranda of understanding for pursuing shared interests.

A joint Sandia/Lockheed Martin team led by Doug Adkins developed the award-winning SnifferStar™, which mounts on drone aircraft to check for chemical weapons on a battlefield.



Among Sandia's many successful collaborations are those with:

- The Goodyear Tire and Rubber Co. to reduce tire cost and production time.
- Ford Motor Co. to evaluate the effectiveness of a cold-spray deposition process for powertrain components, engine bores, and tooling applications.

Sandia's Stan Atcitty worked with Virginia Tech researchers to develop this emitter turnoff thyristor that allows a utility to quickly convert energy stored in a direct current device into alternating current power.

- EMCORE Corp. to develop high-speed optical transceiver modules that promise to make short-haul fiber optic communications faster and less expensive.
- General Atomics to perfect the day/night, all-weather synthetic aperture radar and to develop solid-state, high-operating-temperature, environmentally safe batteries.
- Lockheed Martin to develop sensors, power systems, data transmission and communications, high-performance electronics, and photonics and optical computing.



Technology Ventures Corp. (TVC), established by Lockheed Martin Corp. in 1993, works with Sandia to identify technologies with commercial potential, coordinates the development of business capabilities, and seeks sources of risk capital. TVC has helped capitalize and launch about 55 businesses, creating more than 5,600 jobs and \$410 million in investments.

The Sandia Science and Technology Park, a 200-acre campus-like setting just outside Kirtland Air Force Base in Albuquerque, is home to nine companies, 600 employees, and a state-of-the-art infrastructure.

Business and industry can tap into Sandia and other technical entities along the New Mexico Technology Corridor, which stretches from Los Alamos National Laboratory northwest of Santa Fe to New Mexico State University just north of the Mexican border. Other institutions within the corridor include Sandia, the U.S. Air Force Research Laboratory Phillips Research Site, the University of New Mexico, White Sands Missile Range, the Lovelace Respiratory Research Institute, and the New Mexico Institute of Mining and Technology.



Goodyear Tire and Rubber and Sandia have been strategic partners since 1992, working together in computational engineering design to help both groups reduce manufacturing costs while improving product performance.

User Facilities

Many of Sandia's unique research and development facilities are available for use by U.S. industry, universities, other laboratories, government agencies, and the scientific community.

Sandia/Caterpillar Optical Research Engine Lab in California is used to develop understanding to reduce pollutants and enhance efficiency of diesel engines.



User facility agreements, which can be executed in as few as 30 days, require a statement of work prepared by technical representatives from Sandia and the sponsor. Each project must show benefit to the Department of Energy as well as the user. A company representative performs the work at the facility and Sandia provides

support staff for maintenance and safety procedures.

The agreements allow use of the physical facilities, equipment, instrumentation, scientific expertise, and necessary operational personnel. Among the facilities available are:

A research team surveys heliostats at Sandia's National Solar Thermal Test Facility, devoted to the development and use of solar energy.



- Advanced Battery Engineering Facility
- Center for Security Systems
- Combustion Research Facility
- Design, Evaluation, and Test Facility
- Electronic Technologies Facility
- Engineering Sciences Experimental Facilities
- Explosive Components Facility
- Extreme Ultraviolet Lithography Laboratory
- Geomechanical Laboratory
- Intelligent Systems and Robotics Center
- Ion Beam Materials Research Laboratory
- Manufacturing Technologies Center
- Materials and Process Diagnostics Facility
- Mechanical Test and Evaluation Facility
- National Solar Thermal Test Facility
- Nuclear Facilities Resource Center
- Orpheus Test Range (oil/geothermal drilling)
- Photovoltaic Sciences Facility
- Plasma Materials Test Facility
- Primary Standards Laboratory
- Pulsed Power and Systems Validation Facility
- Radiant Heat Facility
- Radiation Detector Analysis Laboratory
- Shock Technology and Applied Research (STAR) Facility

For more information:

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Our People

Sandia has about 8,500 (full-time equivalent) employees, located primarily in Albuquerque, N.M., and Livermore, Calif. Sandians also work at the Pantex Plant near Amarillo, Texas, the Waste Isolation Pilot Plant near Carlsbad, N.M., the Kauai Test Facility in Hawaii, and the Tonopah Test Range in Nevada. The workforce consists of highly educated and highly skilled engineers, scientists, technologists, and administrative support staff. Among the Labs' employees, almost 1,500 hold doctoral degrees and about 2,400 have master's degrees.

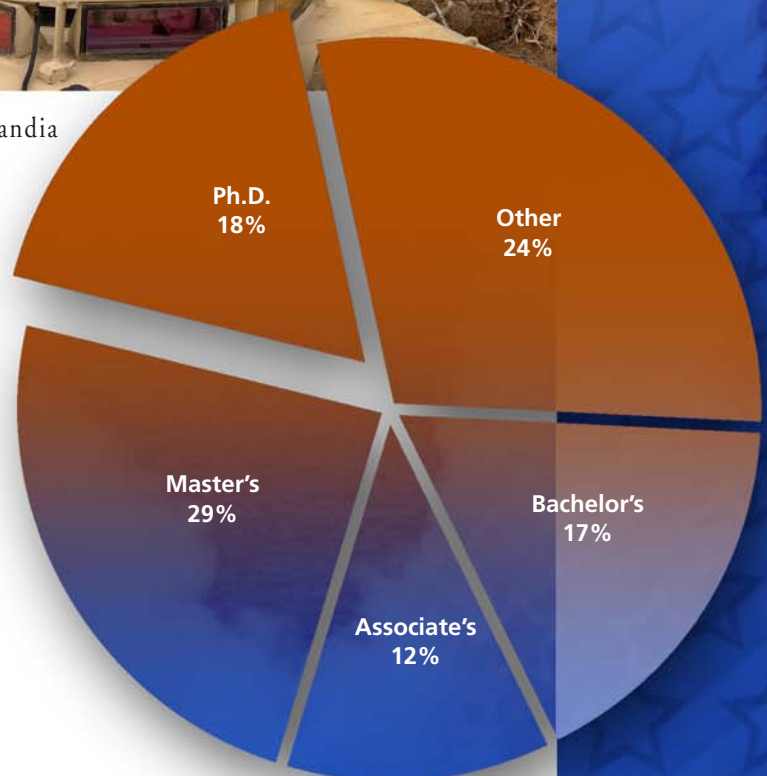
Sandians each year are recognized for a variety of breakthrough technologies, technical excellence, lifetime achievements, and contributions to national security. Through 2004, Sandians had received 70 R&D 100 Awards, presented by *R&D Magazine* to the developers of the year's most significant technical developments. Seven Sandians have received prestigious E. O. Lawrence Awards and six have received Distinguished Associate Awards from the U.S. Department of Energy. Sixteen Sandia individuals or teams have won Lockheed Martin Corp. Nova Technology Awards. In addition, many Sandians each year are recognized by their peers and with awards presented by professional organizations.

Sandia is committed to being an employer of choice, emphasizing quality of life as well as career opportunities that include developing cutting-edge technologies and working on national security challenges under the mentorship of some of America's best and brightest scientists and engineers.

Sandia is an equal opportunity employer.

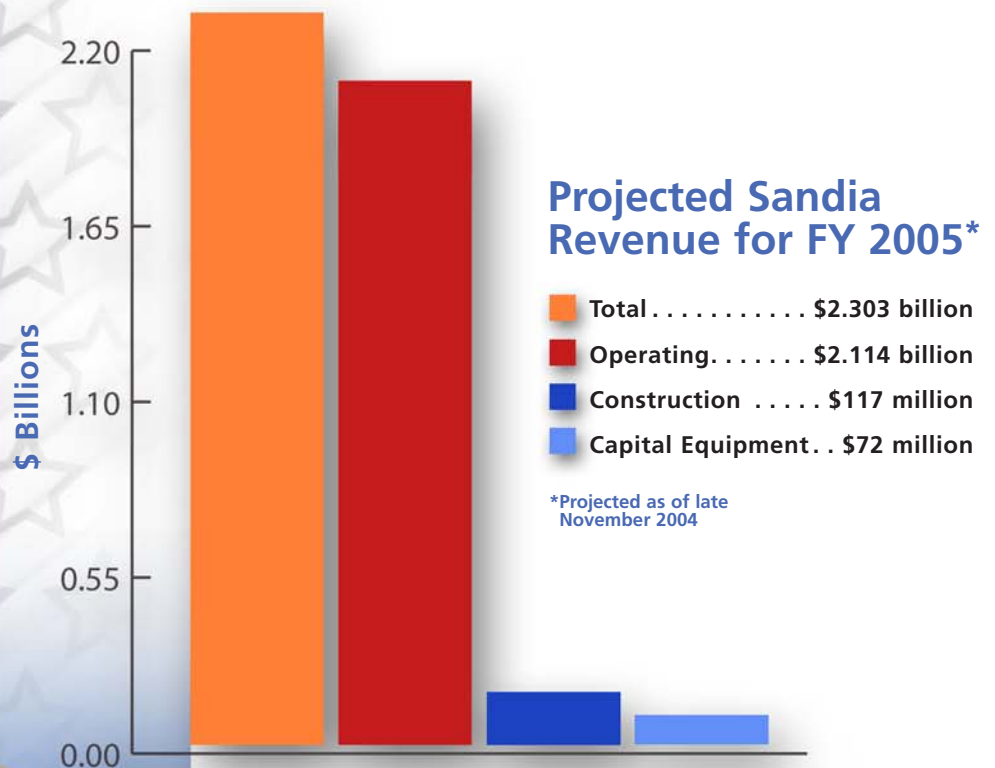


Sandia developed shoulder-to-hand protective sleeves for combat personnel riding atop military vehicles. Demonstrated here by the soldier at top, the body armor protects arms against blast and flying debris effects.



**Regular Workforce
by Degree Level**

Budget



Virginia Vigil aligns a newly framed wall at a Habitat for Humanity house completed in Albuquerque by Sandia employees and retirees.

Community Involvement

Sandians have long maintained a tradition of community service. We believe community involvement is an important part of being a good corporate citizen.

Sandia's community involvement focuses on growth strategies, workforce development, youth education, transportation issues, leadership programs, business development, and strong contributions programs. Sandia provides major economic benefits locally, regionally, and nationally through its approximately 8,500 employees, who generate a payroll of about \$750 million in direct salaries and contract labor.

Sandia as a corporation and Sandians as individuals are known for their commitment to building the health of their communities

through contributions of personal time and resources. This tradition is strongly supported by Lockheed Martin Corp. Sandians annually volunteer tens of thousands of hours to helping others.

Sandia employees and retirees contribute about \$2.5 million to charitable organizations through the Laboratories' annual giving campaigns — the Employee Contribution Plan for United Way of Central of New Mexico and the Livermore Employee Assistance Program in California.

Employees support many other good causes with money, gifts, and time, particularly during the end-of-year holiday season. One such holiday-season program — now a nearly 50-year tradition — is the Shoes for Kids program, which each year provides shoes for hundreds of needy Albuquerque-area elementary-school-aged children. Make a Difference Day, a national day of volunteering, prompts many Sandians, retirees, and their families to pack holiday food boxes, paint and repair homes of the elderly, and offer assistance to local charitable organizations.

Sandia's commitment to education focuses on educational outreach programs that help set the stage for scholastic success. Sandians each year judge science fairs, speak at career events, help teach in classrooms, and serve as mentors and tutors. Sandia's National Atomic Museum offers educational programs that touch thousands of schoolchildren each year.

Sandia internships bring nearly a thousand students to the Albuquerque and Livermore sites each year to work on Sandia projects and learn about the Labs.

More than 450 youngsters in the Albuquerque area get new shoes each year as a result of Sandia's annual Shoes for Kids drive.



A young lady gets a real charge out of her experience at a Sandia-sponsored "Fun in the Sun Science Day."



Did You Know?

Joe Cesarano shows how Sandia's patented ceramic material could fit inside a jawbone and substitute for a bone implant until healthy, newly grown bone and blood vessels weave their way through it.

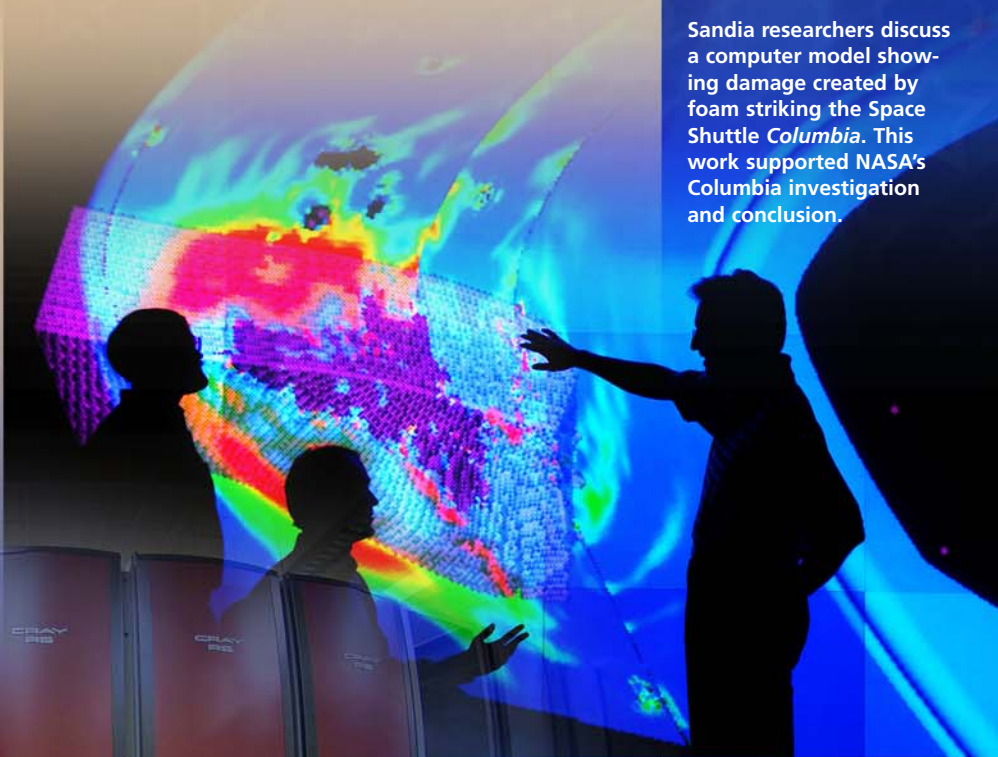


- Sandia designs and develops more than 90 percent of the 3,000-6,500 components in a modern nuclear weapon. Since 1993, Sandia has also manufactured some of the most complex nuclear weapon components.
- Sandia played a key role in helping NASA determine that foam debris impacting the orbiter wing during launch most likely caused the 2003 space shuttle Columbia disaster.
- Sandia is building major new facilities to enable the laboratory to become a world leader in nanotechnology and microsystems engineering.
- Sandia and Lockheed Martin jointly developed the SnifferStar™ chemical sensor that operates on unmanned aerial vehicles and relays reports on chemical detections within 20 seconds of air sampling.
- Sandia invented the cleanroom in 1960, helping to spark today's multibillion-dollar microelectronics industry.
- Sandia's pulsed power program is bringing science a giant step closer to understanding and realizing the development of fusion as an energy source.
- Sandia developed technology that can electronically "sniff" airline passengers before they board and determine whether they have handled explosives recently.
- Sandia research has spawned a number of medical advancements, including a glucose sensor to help diabetics and a promising technology that may soon allow implanting a strong, porous mesh into patients, providing a scaffolding that allows newly grown bone and blood vessels to weave their way through.
- Sandia operates one of the world's most advanced robotics and intelligent machines facilities.
- Sandia's major full-scale testing facilities include a two-mile-long rocket sled track, centrifuges, solar tower, and burn areas. A new thermal test facility will allow burn tests for large objects in a contained structure.

- Sandia and Law Enforcement Technologies, Inc., jointly developed a tool that allows police officers and military personnel to instantly determine on the scene whether a suspect has recently fired a gun.
- For more than 40 years, Sandia has designed sensors and other systems for satellites that continuously monitor the globe for clandestine nuclear tests.
- Five generations of Sandia-developed radiation-hardened microchips have ensured that electronics in defense and space hardware can operate in high-radiation environments.
- Sandia modeling efforts supported and helped guide the National Transportation Safety Board to confirm that the TWA 800 accident of July 1997 most likely was the result of an unintended ignition of the fuel-air mixture in a fuel tank.

Sandia's Red Storm computer will be completed in 2005. With an initial speed of 40 trillion operations per second, it will become one of the most powerful computers on the planet.

Sandia researchers discuss a computer model showing damage created by foam striking the Space Shuttle *Columbia*. This work supported NASA's *Columbia* investigation and conclusion.



For more information about Sandia, please contact the Public Relations and Communications Center at (505) 844-4902 or visit our Web site at <http://www.sandia.gov> for Sandia/New Mexico and <http://www.ca.sandia.gov> for Sandia/California.





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